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(54) Process for improving the yield of distillables in hydrogen donor diluent cracking.

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Description

This invention relates to a process for upgrading high-boiling, hydrocarbon oils to produce lower-boiling hydrocarbons.

Hydrogen donor diluent hydrocracking has been known for many years for upgrading heavy, high-boiling hydrocarbon oils, including tar sands bitumen of the Athabasca type and residua thereof. In such processes, a feedstock, which can be whole bitumen but is more commonly an atmospheric or vacuum residuum, is treated at elevated temperatures with a hydrogen-donating hydrocarbon in the absence of catalyst. The hydrogen-donating hydrocarbon is generally a partially hydrogenated aromatic material, boiling in the range from 180°C to 450°C, for example tetralin, substituted tetralins and partially hydrogenated three- and four-fused-ring aromatic compounds. One such process is disclosed in CA-A-1 122 914. In that process an Athabasca tar sands bitumen was upgraded by hydrocracking its residuum in the presence of a recycled hydrogen donor material obtained by separating particular portions of the effluent from the donor hydrocracking zone and catalytically rehydrogenating a specific portion so produced.

In US-A-2 953 513 it was disclosed that certain distillate thermal tars boiling above 371°C will, when partially hydrogenated, produce a hydrogen donor material suitable for hydrocracking heavy feedstocks at temperatures above 427°C. A portion of the required hydrogen donor material could be supplied by rehydrogenation of a particular fraction of the product materials from the thermal hydrocracking stage.

Solvent deasphalting is a well-known method for separating petroleum residua into an aspaltene fraction which contains a high proportion of the highest molecular weight compounds, together with inorganic matter and other compounds which are substantially insoluble in the selected solvent, and a deasphalted, lower molecular weight oil fraction which is relatively more soluble in the solvent. In the practice of deasphalting by solvent extraction, the deasphalting feedstock is mixed with a solvent chosen for its ability selectively to dissolve desirable low molecular weight hydrocarbons and to reject by precipitating them, the high molecular weight hydrocarbons and other low-value materials mentioned above. Most commonly used as solvents in the process are low-boiling aliphatic hydrocarbons including propane, butane, pentane, hexane and heptane and the corresponding mono-olefins. The solvent-to-feedstock ratio is chosen together with the solvent type so that the optimum separation of desirable low-boiling hydrocarbons is obtained.

Solvent deasphalting has been combined with certain other upgrading steps. For example, US-A-3 775 293 discloses the deasphalting of a black hydrocarbonaceous oil combined with deresining of the deasphalted oil and separate catalytic hydrotreatment of the resins and the deresined oil. In addition, the bottoms of the hydrotreated resins product was thermally cracked and the thermal cracker effluent was fed together with the deasphalted oil to one of the caralytic hydrotreatment zones.

US-A-4 200 519 discloses the combination of multiple thermal cracking zones with the deasphalting of the residuum of the first thermal cracking zone. The deasphalted oil was fed together with certain components from the first thermal cracking zone, to a second thermal cracking zone.

US-A-4 400 264 describes a process in which a deasphalting step was combined with multiple thermal cracking zones and a catalytic hydrotreating zone. The material fed to the catalytic hydrotreating step was comprised of the bottoms from each of the thermal cracking zones and the rejected material, primarily asphaltenes, from the deasphalting zone.

US-A-4 395 324 discloses a process for hydrogen donor diluent cracking of a heavy hydrocarbon charge stock with a heavy hydrogen donor stream which is obtained by atmospheric distillation of the cracking zone effluent, solvent extraction of the distillation bottoms, to separate polycyclic aromatic and heterocyclic compounds having 14 or more carbon atoms, and subjecting these polycyclic compounds to a hydrogen-transfer reaction with lighter hydrogen donors such as tetralin to convert them into polycyclic hydrogen donors which are recycled for use as the heavy hydrogen donor stream. The lighter hydrogen donors are regenerated by a separate hydrotreatment of light products separated from the heavy hydrogen donors by distillation.

The present invention is concerned with increasing the production of distillable materials from bitumens and other heavy oils, and provides a process for converting a feedstock comprising a heavy, high-boiling hydrocarbon oil residuum to produce lower-boiling hydrocarbons, by

(a) thermally hydrocracking said feedstock with hydrogen donor diluent in a hydrogen donor diluent cracking zone, producing a hydrocracked product stream,

(b) fractionating said hydrocracked product stream into at least one distillable fraction and a hydrocracked residuum fraction, and

(c) contacting said hydrocracked residuum fraction with an exacting solvent to produce a deasphalted oil fraction and an asphaltenes-rich residue.

According to the invention, the deasphalted oil fraction has a bottoms fraction with a boiling point of at least 500°C, and at least this bottoms fraction is recycled without hydrogenation to said hydrogen donor diluent cracking zone where it is thermally hydrocracked together with said first residuum fraction.

In drawings that illustrate preferred embodiments of the invention:

Fig. 1 is a process flow diagram illustrating an industrial application of the process of the invention and

Fig. 2 is a process flow diagram showing a variation incorporating separate atmospheric and vacuum distillation zones.

All boiling points described in the present disclosure and claims refer to a pressure of one atmosphere, and all yields and compositions are expressed in weight percent, unless otherwise noted.

The process of the invention also comprehends fractionating the deasphalted oil fraction obtained in the extraction zone to obtain at least one deasphalted oil distillate fraction and a deasphalted oil bottoms fraction, and returning the deasphalted oils bottoms fraction as the recycle stock. The feedstock can be atmospheric or vacuum residuum of conventional crude or of heavy oil, for example Lloydminster, Saskatchewan, or of oil sands bitumen, for example Athabasca or Pelican, Alberta; alternatively it can be whole bitumen where the content of distillables in the bitumen does not justify separately distilling it; or it can be a mixture of these materials.

Referring to Figure 1, a high-boiling hydrocarbon residuum is fed by line 14 to hydrogen donor cracking zone 2. The initial boiling point of this residuum is at least 350°C; typically, its initial boiling point is in the range 500°C to 540°C. This residuum is combined with recycle stock, described hereinafter, from line 26 and with hydrogen donor materials from line 13, optionally containing partially hydrogenated recycled donor materials from line 29, and fed to hydrogen donor cracking zone 2. The ratio of hydrogen donor material to residuum can be from 0.5:1 to 4:1. Optionally, molecular hydrogen is added to donor cracking zone 2 at line 15. The hydrogen donor diluent cracking zone 2 is maintained at a temperature of 380°C to 500°C, preferably 400°C to 460°C, and at an absolute pressure of 2 MPa to 35 MPa, preferably 2 MPa to 15 MPa and most preferably 2.5 MPa to 6 MPa if molecular hydrogen is not present; the pressure will preferably be from 6 MPa to 35 MPa if molecular hydrogen is present. The liquid space velocity of the reaction mass can be from 0.5 to 30h^{-1}, preferably 0.8 to 7.0 h^{-1}. Donor hydrocracking is accomplished in donor cracking zone 2 in the absence of added catalyst.

Effluent from hydrogen donor cracking zone 2 is passed by line 16 to product fractionation zone 3, which includes an atmospheric pressure fractionation zone and optionally a vacuum fractionation zone. Gases and naphtha are removed by lines 17 and 18 respectively, although it is not necessary for the purposes of the invention to separate gases from naphtha and the two products can be withdrawn in a single overhead line if desired. Hydrocracked distillate in line 19 can be taken to further processing; optionally, at least a portion of the material in line 19, boiling in the range of 200°C to 400°C, preferably 200°C to 360°C, can be passed by line 24 to donor rehydrogenation zone 5, which will be described hereinafter. Hydrocracked product residuum boiling above 360°C is withdrawn by line 21. Under certain circumstances, it may be desirable to withdraw a fraction at line 20, which boils in a range higher than the maximum boiling point of material in line 19 and lower than the minimum boiling point of hydrocracked residuum in line 21. Generally, however, it is convenient not to take out so narrow a gas oil cut between the exhausted donor stream 19 and the hydrocracked residuum stream 21, and thus where no material is withdrawn by line 20, the minimum boiling point of the hydrocracked residuum withdrawn at line 21 is approximately the maximum boiling point of thê hydrocracked distillate in line 19. The selection of the cut points of the distillation point is influenced by, among other things, the desired viscosity of deasphalted oil to be produced in deasphalting zone 4.

Where product fractionation zone 3 comprises a vacuum fractionator such that the hydrocracked residuum stream 21 has an initial boiling point of at least 500°C, recycle stock in line 26 inherently boils above 500°C also, and can be returned directly to the donor hydrocracking zone 2. Also when hydrocracked residuum stream 21 boils above 500°C, it is convenient to withdraw a vacuum gas oil stream at line 20.

Hydrocracked bottoms stream 21 is passed to deasphalting zone 4, where it is contacted with a low-boiling selective solvent, for example, a hydrocarbon containing from 3 to 8 carbon atoms in the molecule. The operation of deasphalting zone 4 can be controlled by the manipulation of several variables well-known to those skilled in the art. The pimary consideration in the solvent extraction step is to improve the quality of the recycled stock by selectively rejecting non-upgradable components of the hydrocracked bottoms, including metallic compounds and ash, coke and coke precursors which could not be allowed to build up continuously in a recycled bottoms stream. To meet this objective, the person skilled in the art can manipulate the, among other variables, choice of solvent, including mixed solvents, the ratio of solvent to bottoms in the extraction step, the temperature of extraction and the concomitant pressure required to maintain the solvent in the liquid phase, and the number of stages in the extraction step. The person skilled in the art will be aware that the amount of materials rejected can be decreased by employing a solvent of higher solvent power for high-molecular-weight hydrocarbons; among the aliphatic hydrocarbons, solvent power for these high-molecular-weight materials increases with increasing carbon number of the solvent. Thus, heptane dissolves more high-molecular-weight hydrocarbons than does propane, and aromatic solvents have considerably higher solvent power than heptane. Thus, the solvent preferably comprises aliphatic hydrocarbons containing at most a small proportion of aromatic hydrocarbons, and preferably substantially no aromatic hydrocarbons. A preferred solvent consists essentially of paraffins or olefins in the range C3 to C7; the most preferred solvent in the present invention is butane or pentane or mixtures thereof. It is essential in the process of the invention that the quality of the recycle stock, as measured by the Conradson Carbon Test (CCT), be at least as high as the quality of the original high-boiling hydrocarbon residuum feedstock in line 14 with which it is mixed for processing in the hydrogen donor diluent cracking zone 2. It will be remembered that the Conradson Carbon Test, which is standardized as ASTM D-189, is a measure of the suitability of heavy hydrocarbon oils for various upgrading processes. The person skilled in the art will thus select the parameters of the solvent extraction step to meet this requirement. Within these constraints, a preferred ratio of solvent to hydrocracked bottoms is from 3:1 to 10:1. Solvent extraction zone 4 is preferably operated at a temperature between 80°C and 200°C and at a pressure sufficient to avoid the formation of substantial amounts of vapours in the extraction zone.

In the solvent extraction zone 4, the hydrocracked residuum from line 21 when mixed with solvent separates into an aspaltenes-rich phase and an oil-rich phase. Solvent is removed from each phase separately by known methods to form an asphaltenes-containing stream 25 which is withdrawn and a deasphalted oil stream 26, which is recycled to the hydrogen donor cracking zone 2. A portion of the deasphalted oil stream 26 can be withdrawn by line 27 if desired, but in most cases it will be preferable to recycle the entire stream 26. Generally, it is preferred to treat all of the product tower bottoms in the solvent extraction zone 4.

As mentioned above, middle distillate is withdrawn from fractionation zone 3 in line 19; at least a portion of stream 19, which is rich in hydrogen donor precursors, can be optionally taken by line 24 to rehydrogenation zone 5. Partial rehydrogenation is accomplished by known methods using molecular hydrogen fed by line 28 under elevated temperature and pressure in the presence of known hydrogenation catalysts, for example cobalt, molybdenum, tungsten and nickel compounds and mixtures thereof. Rehydrogenated donor stream 29, which is withdrawn from hydrogenation zone 5, contains significant amounts of compounds capable of donating hydrogen under donor hydrocracking conditions, for example, tetralin and substituted tetralins. The cut points of the fractionation producing hydrogen donor precursor stream 19 and the severity of the hydrogenation in rehydrogenation zone 5 can be adjusted to enable the optimum production of hydrogen-donating materials. Where the boiling range of the hydrogen donor precursor stream is from 200°C to 360°C, the stream will contain substantial quantities of materials that, although they are not partially rehydrogenated to produce hydrogen-donating compounds, can be converted when recycled through the donor hydrocracking zone 2, into the precursors of active hydrogen-donating compounds. Thus, on further recycle and partial hydrogenation, at least a portion of these higher-boiling materials can be converted and rehydrogenated to form active hydrogen donors. The higher boiling range of hydrogen donor precursor stream 24 also contains materials that themselves form hydrogen-donating compounds, for example dihydroanthracene, upon partial hydrogenation. It must be remembered, however, that the process of the invention is not dependent upon the recycling of hydrogen donor materials.

Referring to Figure 2, a variant of the preferred embodiment of Figure 1 is shown wherein separate atmospheric and vacuum fractionation towers are employed for the distillation of the original crude. Crude oil enters atmospheric distillation zone 51 through line 31 and is separated into one or more streams of atmospheric overheads. For the sake of simplicity, the various streams of overheads are shown combined in stream 32. Atmospheric tower residuum is withdrawn by line 33 and mixed with deasphalted oil in line 45 to be fed by line 34 to vacuum fractionating zone 52. One ore more streams of distillable materials, shown combined in line 35, are removed to leave a vacuum residue which is withdrawn by line 36. The vacuum residue 36 has an initial boiling point of at least 460°C, preferably at least 500°C; in commercial practice, vacuum tower residue generally has an initial boiling point no higher than 540°C. The residue in line 36 is mixed with hydrogen donor materials from line 39, and optionally with partially rehydrogenated hydrogen donor stream 48 and passed into donor hydrocracking zone 53, wherein hydrogen donor diluent cracking is carried out at conditions as described above with reference to Figure 1, optionally in the presence of molecular hydrogen from line 37. A hydrocracked product stream is withdrawn at line 38 and passed to product fractionation tower 54, from which one or more overhead streams shown as 39 are withdrawn. A hydrogen donor precursor stream 40 boiling in the range 200°C to 360°C, may be withdrawn and passed if desired to rehydrogenation zone 56, and product fractionation zone residuum, preferably boiling above 360°C, is withdrawn by line 42 and passed to solvent deaspalting zone 55. Solvent deasphalting zone 55 is operated according to the considerations discussed above. Insoluble asphaltenic residue is withdrawn by line 49 and deasphalted oil recycle stock is returned by lines 44 and 45 to be mixed with atmospheric tower residue from line 33 and passed into vacuum fractionating zone 52 by line 34. Optionally, rehydrogenated donor stream 48 can be prepared by catalytic rehydrogenation of precursor stream 40, described above, in hydrogenation zone 56 to which is fed molecular hydrogen by line 47. Where product fractionation zone 54 is operated at atmospheric pressure and the residuum fed to deasphalting zone 55 has an initial boiling point of about 360°C, it is preferable to feed the recycle stock from line 44 to be vacuum fractionated in vacuum fractionation zone 52 prior to recycling to donor hydrocracking zone 53. Distillable components of the deasphalted oil stream at 44 are thus removed and a second vacuum fractionation zone is avoided; further, the size of donor hydrocracking zone 53 can be minimized. Conversely, if product fractionation zone 54 includes a vacuum fractionation zone, it will usually be preferable to take recycle stock through line 43 directly to donor cracking zone 53. It may be desirable when upgrading some feedstocks, to operate vacuum fractionation zone 52 at conditions in which residuum in line 36 boils above about 540°C, while hydrocracked residuum in line 42 boils above a lower temperature, for example 500°C.

Example 1

A full-range Athabasca bitumen was distilled under atmospheric and then under vacuum conditions to yield a vacuum residuum having an initial boiling point of 504°C and CCT value of 24.6%. All boiling points described herein are corrected to atmospheric pressure. A charge of 334.7 grams of this residuum was mixed with 669.4 grams of a material boiling between 190°C and 300°C and containing hydrogen donating species as listed in Table 1. The mixture was charged to a two-litre stirred autoclave which was raised to a temperature of 435°C for 105 minutes. After cooling, the autoclave pressure was released and the gases collected. The contens of the autoclave were then separated into gases, liquid, residuum and coke products. The yields of the products and their boiling ranges are shown in Table 2. The 88.2 grams of product residuum thus obtained was contacted with a solvent containing primarily pentane, whereby 48.4 grams of deasphalted oil was obtained and 39.8 grams of asphaltenes rejected. In a second stage, the deasphalted oil was further contacted with solvent at a lower temperature, where 10.0 grams of material precipitated, leaving 38.4 grams of second-stage deasphalted oil. The second-stage precipitate, 10.0 grams, was retained as a separate stock for recycle.

TABLE 1

HYDROGEN DONOR DILUENT COMPOSITION

	(mass percent)
Paraffins	11.2
Cycloparaffins	5.6
Alkylbenzenes	14.3
Benzocycloparaffins	44.2
Benzodicycloparaffins	7.5
Naphthalenes	12.5
Naphthocycloparaffins	3.3
Higher aromatics	1.4

The second-stage deasphalted oil and second-stage precipitate, having a combined CCT value of 19.9%, were mixed with 285.2 grams of fresh vacuum residuum and a further treatment of the mixture having a CCT value of 23.9% was done using the same amount of hydrogen donor and the same autoclave conditions as before. The product yields are also shown in Table 2. The last column in Table 2 shows the change in yield on 100 grams of bitumen residuum for the deasphalted oil recycle, over the yield for the non-recycle case.

TABLE 2

PRODUCT YIELDS - SAMPLE I

Feedstock	Run 1	Run 2	Change Run 2-Run 1
Bitumen Residuum	100 parts	85.5 parts	
CCT Value	24.6%	24.6%	
Deasphalted Product Residuum	—	14.5 parts	
CCT	—	19.9%	
Hydrogen Donor Solvent	200 parts	200 parts	
Processing Conditions			
Temperature	435°C	435°C	
Time	105 min.	105 min.	
Yields on Bitumen Feed, %			
Gas (to C3)	14.7	15.2	+0.5
Naphtha (C4 to 200°C)	49.2	58.2	+9.0
Middle Distillate (200-360°C)	−12.1	−15.4	−3.3
Gas Oil (360-504°C)	16.4	20.2	+3.8
Residuum (504°C +)	26.4	17.1	−9.3
Coke	5.5	4.7	−0.8
Conversion to Liquid Products, %	53.5	63.0	+9.5

Example 2

A second sample of Athabasca bitumen was hydrocracked to prepare a product residuum having an initial boiling point of 360°C, which was subjected to a solvent extraction treatment by an outside supplier, using a solvent consisting essentially of pentane, the yield was 72.2 per cent deasphalted product residuum and 27.8 per cent asphaltenes. The deasphalted product residuum was vacuum distilled and the resulting residuum, boiling above 504°C mixed with bitumen residuum feed in the ratio 17.85 parts to 82.15 parts of bitumen residuum, and subjected to a hydrogen donor solvent hydrocracking step by the same method as Example 1. The original bitumen was a different sample from that of Run 1 and 2, and yielded a different product slate; therefore the original bitumen hydrocracking, Run 3, corresponds to Run 1, while the combined bitumen/deasphalted product residuum material was treated in Run 4, corresponding to Run 2. Results are shown in Table 3.

TABLE 3

PRODUCT YIELDS - SAMPLE II

Feedstock	Run 3	Run 4	Change Run 4-Run 3
Bitumen Residuum II 23.2%	100 parts	82.2 parts	
CCT Value	23.2%	23.2%	
Deasphalted Product Residuum	—	17.8 parts	
CCT Value	—	21.2%	
Hydrogen Donor solvent	200 parts	200 parts	
Processing Conditions			
Temperature	435°C	435°C	
Time	105 min.	105 min.	
Yields on Bitumen Feed, %			
Gas (to C3)	16.7	15.1	−1.6
Naphtha (C4 to 200°C)	48.0	52.4	+4.4
Middle Distillate (200-360°C)	−9.7	−12.5	−2.8
Gas Oil (360-504°C)	16.2	25.6	+9.4
Residuum	24.7	15.5	−9.2
Coke	4.1	3.8	−0.3
Conversion to Liquid Products, %	54.5	65.5	+11.0

For comparison, a sample of each of the second stage deasphalted oil and second-stage precipitate of Run 2 was subjected individually to a hydrogen donor hydrocracking process in the same manner as the previous runs. After treatment with hydrogen donor solvent in the ratio 1:2 feedstock to solvent, the products were fractioned and the conversion of residuum to liquids was determined. The second-stage precipitate yielded 31.5 per cent liquid products, while 46.1 per cent of the second-stage deasphalted oil was converted. On a theoretical basis, a mixture in the ratio of 1:3.84 of these two feedstocks would be expected to yield 43.1 per cent liquid products; because the residuum of Run 1 was found to yield 54.9 per cent deasphalted oil, then theoretically, of the 26.4 per cent residuum yield of Run 1, (26.4 x .431 x .549) or 6.25 per cent (absolute basis) can be converted to liquid products. Surprisingly, applicants have found that the improvement in liquid yield by utilizing the process of the invention, at 9.5 per cent, is much greater than would be expected by merely combining the two materials, fresh vacuum residuum and deasphalted hydrocracked product residuum. Furthermore, the improvement in liquid yield was accompanied by a decrease in production of coke and a cecrease or at the very least only a marginal increase in gases. This change is unexpected in view of the normal tendency of bottoms materials recycled to a hydrocracking reaction to degrade to gas and coke.

The process of the invention provides an improved yield of liquid distillable hydrocarbons superior to the liquids yield which is obtained using hydrogen donor hydrocracking alone. Additionally, while the majority of the metallic constituents in the hydrocracked residuum are rejected with the asphaltenes in the solvent deasphalting step, a small portion of metallic components is present in the deasphalted oil. Returning the deasphalted oil to be reprocessed through the donor hydrocracking zone further breaks down metallic compounds so that the metals are ultimately rejected with the asphaltenes. Being non-catalytic, the donor hydrocracking zone avoids catalyst poisoning that can occur in prior art processes where a metals-containing oil is fed to a process zone containing a catalyst. Whereas a simple add-on deasphalting step would pass the deaspalted oil with its metallic impurities directly to second-stage hydrotreating units, the process of the invention provides substantially complete rejection of metals and therefore avoids contamination of catalysts in downstream hydrotreating zones.

Claims

1. A process for converting a feedstock (14; 36) comprising a heavy, high boiling hydrocarbon oil residuum into lower boiling hydrocarbons by:

(a) thermally hydrocracking said feedstock (14; 36) with hydrogen donor diluent (13; 39) in a hydrogen donor diluent cracking zone (2; 53) to produce a hydrocracked productstream (16; 38);

(b) fractionating (3; 54) said hydrocracked product stream into at least one distillate fraction (17, 18, 19, 20; 39, 40) and a hydrocracked residuum fraction (21; 42);

(c) contacting (4; 55) said hydrocracked residuum fraction with an extracting solvent to produce (i) a deasphalted oil fraction (26; 44) and (ii) an asphaltenes-rich residue; (25; 49) and

(d) recycling the deasphalted oil fraction to said hydrogen donor diluent zone (2; 53) characterised in that the deasphalted oil fraction (26; 44) contains a bottoms fraction having a boiling point of at least 500°C, and at least said bottoms fraction is recycled to said hydrogen donor diluent zone without hydrogenation.

A process as claimed in claim 1 characterised by:

(e) fractionating said fractionated deasphalted oil fraction into at least one fractionated deasphalted oil distillate fraction and a deasphalted oil bottoms fraction; and

(f) recycling said fractionated deasphalted oil bottoms fraction as said recycle stock.

3. A process as claimed in claim 1 or claim 2 characterised in that the said recycle stock has a Conradson Carbon Test value no higher than the Condradson Carbon Test valvue of said high boiling residuum.

4. A process as claimed in claim 1 characterised in that the said feedstock consists essentially of hydrocarbon oil residuum.

5. A process as claimed in claim 1 characterised in that the said feedstock is selected from heavy crude oil and oil sands bitumen and residuum thereof.

6. A process as claimed in claim 1 to 3 characterised in that the said hydrocracked residuum fraction has an initial boiling point of that at least about 500°C.

7. A process as claimed in claim 3 characterised in that the said hydrocracked oil distillate fraction includes a donor precursor fraction having a boiling range of from 200°C to 360°C and at least a portion of said donor precursor fraction is partially hydrogenated in a catalytic hydrogenated zone and recycled to form at least a portion of said hydrogen donor diluent.

8. A process as claimed in claim 1 or 7 characterised in that the said feedstock comprises whole crude and is fractionated in a feed fractionation zone comprising an atmospheric feed fractionation zone and a vacuum feed fractionation zone being fed into said donor diluent cracking zone.

9. A process as claimed in claim 8 characterised in that said hydrocracked residuum fraction has an initial boiling point of at least about 360°C.

Patentansprüche

1. Verfahren zum Umwandeln eines Materialstromes (14; 36) mit einem schweren Kohlenwasserstoff-Öl-Rückstand hohen Siedepunktes in Kohlenwasserstoffe niedrigen Siedepunktes durch

(a) thermisches Hydrocracking des Materialstromes (14; 36) mit einem wasserstoffabgebenden Verdünnungsmittel (13; 39) in einer Crackingzone eines wasserstoffabgebenden Verdünnungsmittels (2; 53), um einen hydro-gecrackten Produktstrom (16; 38) zu erzeugen;

(b) Fraktionieren (3; 54) des hydrogecrackten Produktstromes in wenigstens eine Destillationsfraktion (17, 18, 19, 20; 39, 40) und eine hydrogecrackte Rückstandfraktion (21; 42);

(c) Inberührungbringen (4; 55) der hydrogecrackten Rückstandfraktion mit einem extrahierenden Lösungsmittel zum Erzeugen (i) einer deasphaltierten Ölfraktion (26; 44) und (ii) eines asphaltreichen Rückstandes (25; 49); und

(d) Recyclieren der de-asphaltierten Ölfraktion zur wasserstoffabgebenden Verdünnungszone (2; 53),

dadurch gekennzeichnet, daß die de-asphaltierte Ölfraktion (26; 44) eine Bodenfraktion mit einem Siedepunkt von wenigstens 500°C enthält, und daß wenigstens die Bodenfraktion zur wasserstoffabgebenden Verdünnungszone ohne Hydrierung recycliert wird.

2. Verfahren nach Anspruch 1, gekennzeichnet durch

(e) Fraktionieren der fraktionierten de-asphaltierten Ölfraktion in wenigstens eine fraktionierte de-asphaltierte Öldestillatfraktion und eine de-asphaltierte Ölbodenfraktion; und

(f) Recyclieren der fraktionierten de-asphaltierten Ölbodenfraktion als das genannte recyclierte Material.

3. Verfahren nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß das genannte recyclierte Material einen Condradson-Kohlenstoff-Testwert aufweist, der nicht größer als jener des genannten Rückstandes hohen Siedepunktes ist.

4. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß der genannte Materialstrom im wesentlichen aus Kohlenwasserstoff-Öl-Rückstand besteht.

5. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß der genannte Materialstrom ausgewählt ist aus schwerem Rohöl und Ölsandbitumen sowie Rückständen hiervon.

6. Verfahren nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß die genannte hydrogecrackte Rückstandsfraktion einen Anfangssiedepunkt von wenigstens 500°C hat.

7. Verfahren nach Anspruch 3, dadurch gekennzeichnet, daß die genannte hydrogecrackte Öldestillatfraktion eine abgebende Vorläuferfraktion mit einem Siedepunktbereich von zwischen 200°C und 360°C aufweist, und daß wenigstens ein Teil dieser abgebenden Vorläuferfraktion partiell in einer katalytischen hydrierten Zone hydriert und recycliert wird, um wenigstens einen Teil des genannten wasserstoffabgebenden Verdünnungsmittels zu bilden.

8. Verfahren nach einem der Ansprüche 1 bis 7, dadurch gekennzeichnet, daß der genannte Materialstrom vollständiges Rohöl umfaßt und in einer Zufuhr-Fraktionierungszone fraktioniert wird, die eine atmosphärische Zufuhrfraktionierungszone enthält sowie eine Vakuum-Zufuhrfraktionierungszone, die in die genannte abgebende Verdünnungsmittel-Crackingzone eingespeist wird.

9. Verfahren nach Anspruch 8, dadurch gekennzeichnet, daß die hydrogecrackte Rückstandsfraktion einen Anfangssiedepunkt von wenigstens 360°C aufweist.

Revendications

1. Procédé pour convertir une charge d'alimentation (14; 36), comprenant un résidu lourd d'huile hydrocarbonée à point élevé d'ébullition, en des hydrocarbures à plus bas point d'ébullition, par

(a) hydrocraquage thermique de ladite charge d'alimentation (14; 36) à l'aide d'un diluant (13; 39) donneur d'hydrogène dans une zone (2; 53) de craquage en présence du diluant donneur d'hydrogène, pour produire un courant (16; 38) de produits hydrocraqués;

(b) fractionnement (3; 54) dudit courant de produits hydrocraqués en au moins une fraction de distillat (17, 18, 19, 20; 39, 40) et en une fraction de résidu hydrocraqué (21; 42);

(c) mise de ladite fraction de résidu hydrocraqué en contact (4; 55) avec un solvant à rôle d'extraction pour produire (i) une fraction (26; 44) d'huile désasphaltée, et (ii) un résidu (25; 49) riche en des asphaltènes; et

(d) recyclage de la fraction d'huile désasphaltée vers ladite zone (2; 53) de craquage en présence d'un diluant donneur d'hydrogène, procédé cractérisé en ce que la fraction (26; 44) d'huile désasphaltée contient une fraction de queues ayant un point d'ébullition au moins égal à 500°C, et l'on recycle au moins ladite fraction des queues, sans hydrogénation, vers ladite zone de craquage en présence d'un diluant donneur d'hydrogène.

2. Procédé tel que renvendiqué à la revendication 1, caractérisé par:

(e) le fractionnement de ladite fraction d'huile désasphaltée fractionnée pour obtenir au moins une fraction de distillat d'huile désasphaltée fractionnée et une fraction de queues d'huile désasphaltée; et

(f) le recyclage, à titre de matière de recyclage, de ladite fraction de queues d'huile désasphaltée fractionnée.

3. Procédé tel que revendiqué à la revendication 1 ou 2, caractérisé en ce que ladite matière de recyclage présente une valeur à l'essai de détermination de la teneur en carbone Conradson, non supérieure à la valeur de l'essai de carbone Conradson dudit résidu à point élevé d'ébullition.

4. Procédé tel que revendiqué à la revendication 1, caractérisé en ce que ladite charge d'alimentation consiste essentiellement en du résidu d'huile hydrocarbonée.

5. Procédé tel que revendiqué à la revendication 1, caractérisé en ce que ladite charge d'alimentation est choisie parmi de l'huile brute lourde, du bitume de sable asphaltique et leur résidu.

6. Procédé tel que revendiqué à la revendication 1 à 3, caractérisé en ce que ladite fraction de résidu hydrocraqué présente un point initial d'ébullition au moins égal à environ 500°C.

7. Procédé tel que revendiqué à la revendication 3, caractérisé en ce que ladite fraction de distillat d'huile hydrocraquée comprend une fraction de précurseur de donneur, ayant une gamme d'ébullition comprise entre 200°C et 360°C, et en ce qu'au moins une partie de ladite fraction de précurseur de donneur est partiellement hydrogénée, dans une zone d'hydrogénation catalytique, et elle est recyclée pour former au moins une partie dudit diluant donneur d'hydrogène.

8. Procédé tel que revendiqué à la revendication 1 ou 7, caractérisé en ce que ladite charge d'alimentation comprend du brut entier et est fractionnée, dans une zone de fractionnement de l'alimentation, comprenant une zone de fractionnement d'alimentation (sous la pression) atmosphérique et une zone de fractionnement de l'alimentation sous vide, dont le produit est envoyé dans ladite zone de craquage du diluant donneur.

9. Procédé tel que revendiqué à la revendication 8, caractérisé en ce que ladite fraction de résidu hydrocraqué présente un point initial d'ébullition au moins égal à environ 360°C.

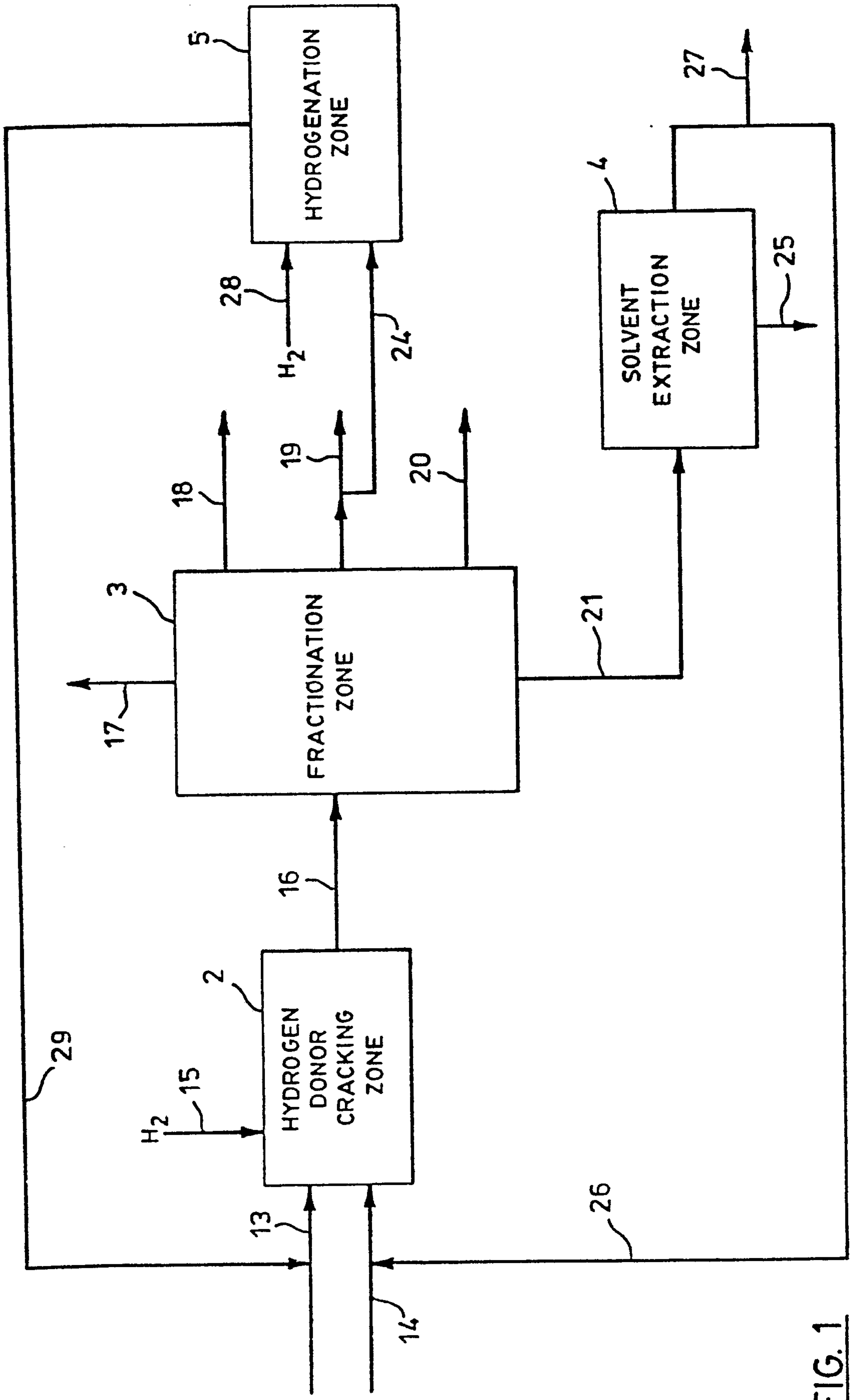
HYDROGEN DONOR CRACKING ZONE
FRACTIONATION ZONE
HYDROGENATION ZONE
SOLVENT EXTRACTION ZONE
H_2
H_2
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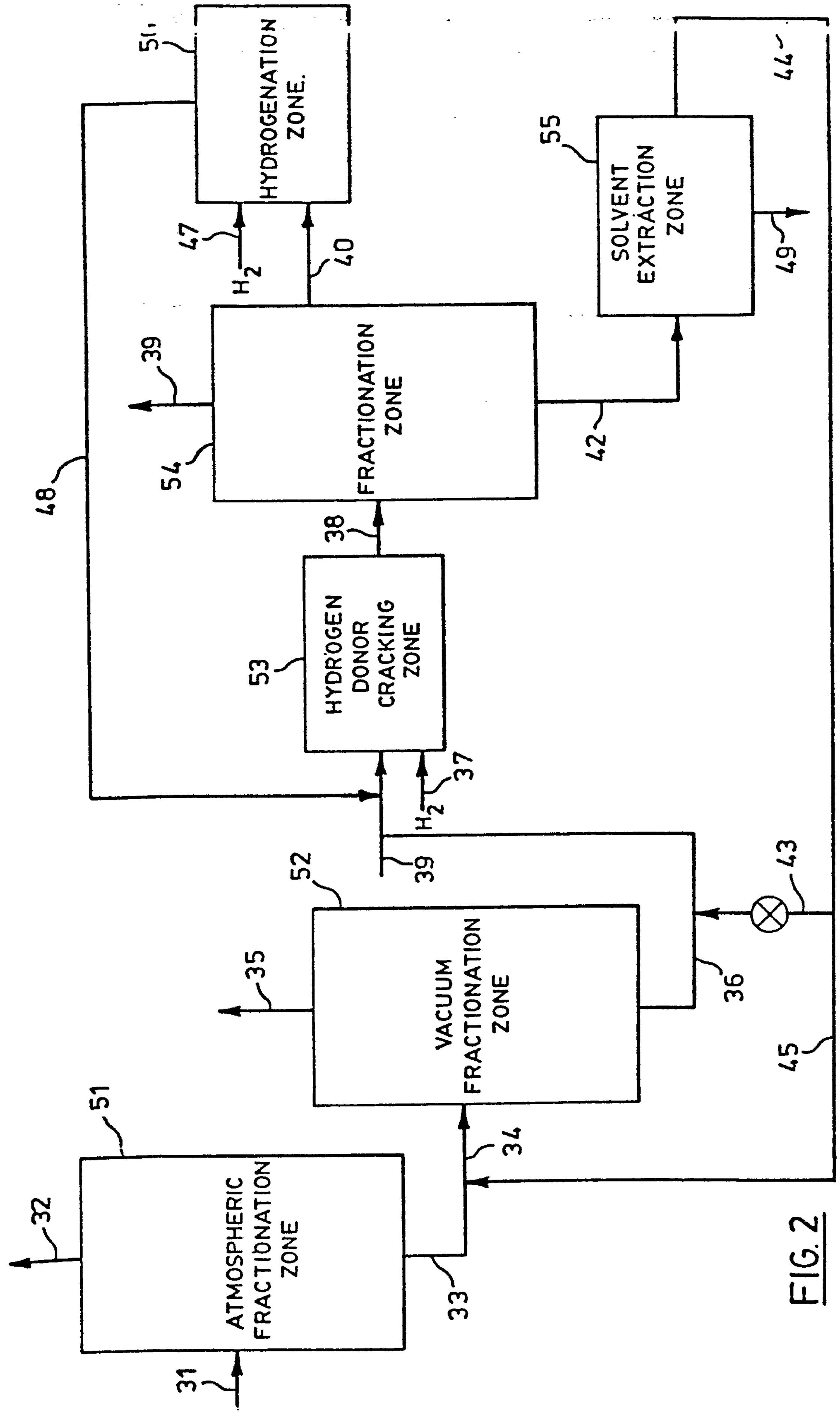
FIG. 1


ATMOSPHERIC FRACTIONATION ZONE
VACUUM FRACTIONATION ZONE
HYDROGEN DONOR CRACKING ZONE
FRACTIONATION ZONE
HYDROGENATION ZONE.
SOLVENT EXTRACTION ZONE
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H_2
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FIG. 2